

IN THE CLAIMS

Please amend the claims as shown below. A complete listing of the claims is provided.

1. (Currently Amended) An optical element having a substrate formed by an optical material, said substrate comprising:

a convex part functioning as a convex lens;

a flat part positioned around said convex part; and

an outer circumference part positioned around said flat part, wherein

a thickness of said outer circumference part is greater than that of said flat

part, and greater than said convex part.

whereby the mechanical strength is improved and the resonance frequency is increased.

2. (Canceled)

3. (Original) An optical element as set forth in claim 1, wherein said substrate comprises a first groove formed at a boundary between said convex part and said flat part, for defining a region of said convex part.

4. (Original) An optical element as set forth in claim 3, wherein said substrate comprises a second groove formed at a boundary between said flat part and said outer circumference part, for defining a region of said flat part.

5. (Original) An optical element as set forth in claim 1, wherein said optical material comprises fused silica.

6. (Original) An optical element as set forth in claim 1, wherein a surface of said outer circumference part is flat or approximately flat and thereby holding is eased.

7. (Original) An optical element as set forth in claim 1, wherein a plurality of steps are formed at said outer circumference part, the thickness of said substrate at an outer side step is thicker than that of said substrate at an inner side step, and thereby eclipse is prevented.

8. (Original) An optical element having a substrate formed by an optical material, said substrate comprising:

- a convex part functioning as a convex lens;

- a flat part positioned around said convex part;

- an outer circumference part positioned around said flat part;

- a first groove formed at a boundary between said convex part and said flat part, for defining a region of said convex part; and

- a second groove formed at a boundary between said flat part and said outer circumference part, for defining a region of said flat part, wherein

- a thickness of said outer circumference part is greater than that of said flat part;

- both said flat part and said outer circumference part comprise flat shapes in the thickness direction; and

said convex part, said flat part, and said outer circumference part are integrated in a unit by said substrate.

9. (Original) An optical element having a substrate formed by an optical material, said substrate comprising:

a convex part functioning as a convex lens;

a flat part positioned around said convex part;

an outer circumference part positioned around said flat part; and

a groove formed at a boundary between said convex part and said flat part, for

defining a region of said convex part, wherein

a thickness of said outer circumference part is greater than that of said convex

part;

both said flat part and said outer circumference part comprise flat shapes in the

thickness direction; and

said convex part, said flat part, and said outer circumference part are

integrated in a unit by said substrate.

10. (Currently Amended) An optical element having a substrate formed by an optical material,

said substrate comprising:

a convex part functioning as a convex lens;

a flat part positioned around said convex part;

a first outer circumference part positioned around said flat part;

a second outer circumference part positioned around said first outer circumference part;

a [third] first groove formed at a boundary between said convex part and said flat part, for defining a region of said convex part; and

a [fourth] second groove formed at a boundary between said flat part and said first outer circumference part, for defining a region of said flat part, wherein

a thickness of said first and second outer circumference parts are greater than that of said flat part and the thickness of said second outer circumference part is greater than that of said first outer circumference part;

all said flat part and said first and second outer circumference parts comprise flat shapes in the thickness direction; and

said convex part, said flat part, and said first and second outer circumference parts are integrated in a unit by said substrate.

11. (Canceled) A method for producing an optical element comprising the steps of forming a first mask layer and a second mask layer surrounding said first mask layer on a substrate formed by an optical material;
heat treating said first mask layer to form it into a convex lens shape; and
etching said substrate to transfer said convex lens shape of said first mask layer to said substrate.

12. (Canceled) A method for producing an optical element as set forth in claim 11, wherein the step for forming said first and second mask layers comprises patterning a mask layer formed by a photosensitive material on said substrate to form said first and second mask layers.

13. (Canceled) A method for producing an optical element as set forth in claim 11, wherein, in the step for heat treating said first mask layer to form it into a convex lens shape, the heat treatment temperature is higher than a glass transition temperature of said first mask layer.

14. (Canceled) A method for producing an optical element as set forth in claim 11, wherein, in the step for heat treating said first mask layer to form it into a convex lens shape, the heat treatment temperature is lower than a carbonization temperature of said first mask layer.

15. (Canceled) A method for producing an optical element as set forth in claim 11, wherein, in the step for heat treating said first mask layer to form it into a convex lens shape, the heat treatment temperature is higher than room temperature or ordinary temperature.

16. (Canceled) A method for producing an optical element as set forth in claim 11, wherein:

the step for forming said first and second mask layers comprises forming said second mask layer having an opening part, then forming said first mask layer at said opening part; and

said second mask layer is formed by an etching-resistant material.

17. (Canceled) A method for producing an optical element as set forth in claim 11, wherein:

said second mask layer comprises

a third mask layer formed by an etching-resistant material and

a fourth mask layer superposed on said third mask layer so as to cover said third mask layer on said substrate; and

said fourth mask layer is formed by the same material as said first mask layer.

18. (Canceled) A method for producing an optical element as set forth in claim 11, wherein

said substrate is formed by fused silica,

said first mask layer is formed by an optically transparent material having a good characteristic for forming a thick film, and

said second mask layer is formed by platinum.

19. (Canceled) A method for producing an optical element as set forth in claim 17, wherein

- said third mask layer is formed by platinum and
- said fourth mask layer is formed by an optically transparent material having a good characteristic for forming a thick film.

20. (Currently-Amended) An optical pickup comprising:

- an optical element functioning as an object lens when mounted on a recording and/or reproducing apparatus of an optical storage medium and
- a photodetector for receiving a reflected light beam for use in recording and/or reproduction to and from the optical storage medium,
- the optical element comprising a substrate formed by an optical material,
- the substrate comprising
- a convex part functioning as a convex lens,
- a flat part positioned around the convex part, and
- an outer circumference part positioned around the flat part,
- a thickness of the outer circumference part being thicker than that of the flat part and greater than that of said flat part, to thereby improve mechanical strength and increase a resonance frequency.

21. (Canceled)

22. (Original) An optical pickup as set forth in claim 20, wherein a surface of said outer circumference part is flat or approximately flat and thereby holding of said optical element is eased.

23. (Currently Amended) An optical pickup comprising:
an optical element functioning as an object lens when mounted on a recording and/or
reproducing apparatus of an optical storage medium and a photodetector for receiving a
reflected light beam for use in recording and/or reproduction to and from the optical storage
medium, the optical element comprising a substrate formed by an optical material,
the substrate comprising a convex part functioning as a convex lens,
a flat part positioned around the convex part, and an outer circumference part positioned
around the flat part, a thickness of the outer circumference part being thicker than that of the
flat part to thereby improve mechanical strength and increase a resonance frequency [An optical pickup as set forth in claim 20], wherein a plurality of steps are formed at said outer circumference part, the thickness of said substrate at an outer side step is greater than that of said substrate at an inner side step, and thereby eclipse is prevented.

Please add the following new claims 24 to 32 based on combinations of claims 1 through 7 originally found allowable, as follows:

24. (Newly-added) An optical element having a substrate formed by an optical material, said substrate comprising:

a convex part functioning as a convex lens;

a flat part positioned around said convex part; and

an outer circumference part positioned around said flat part, wherein a thickness of said outer circumference part is greater than that of said flat part, and wherein said substrate comprises a first groove formed at a boundary between said convex part and said flat part, for defining a region of said convex part.

25. (Newly-added) An optical element as set forth in claim 24, wherein the thickness of said outer circumference part is greater than that of said convex part.

26. (Newly-added) An optical element as set forth in claim 24, wherein said substrate comprises a second groove formed at a boundary between said flat part and said outer circumference part, for defining a region of said flat part.

27. (Newly-added) An optical element as set forth in claim 24, wherein said optical material comprises fused silica.

28. (Newly-added) An optical element as set forth in claim 24, wherein a surface of said outer circumference part is flat or approximately flat and thereby holding is eased.

29. (Newly-added) An optical element as set forth in claim 24, wherein a plurality of steps are formed at said outer circumference part, the thickness of said substrate at an outer side step is thicker than that of said substrate at an inner side step, and thereby eclipse is prevented.

30. (Newly-added) An optical element having a substrate formed by an optical material,

said substrate comprising:

a convex part functioning as a convex lens;

a flat part positioned around said convex part; and

an outer circumference part positioned around said flat part, wherein

a thickness of said outer circumference part is greater than that of said flat part, wherein said optical material comprises fused silica.

31. (Newly-added) An optical element having a substrate formed by an optical material,

said substrate comprising:

a convex part functioning as a convex lens;

a flat part positioned around said convex part; and

an outer circumference part positioned around said flat part, wherein

a thickness of said outer circumference part is greater than that of said flat part, wherein a plurality of steps are formed at said outer circumference part, the thickness of said substrate at an outer side step is thicker than that of said substrate at an inner side step, and thereby eclipse is prevented.

32. (Newly-added) An optical element as set forth in claim 31, wherein said substrate comprises a first groove formed at a boundary between said convex part and said flat part, for defining a region of said convex part.